

## Efficient, Multi-scale Radiation Transport Modeling, Phase I

Completed Technology Project (2009 - 2009)



## Project Introduction

Focusing on a reduced-dimension problem of a hypersonic orbital/lunar reentry capsule, an algorithm will be built which combines the stochastic Monte Carlo method for treatment of radiation transport in optically thin to moderate domains, with a single-term modified differential approximation (MP1) for use in optically thick domains. This numerical method will be verified against a known benchmark case before application to the reentry problem. The bandwise and cumulative distribution function (CDF) methods will be combined within the Monte Carlo framework, creating an efficient, dual-hybrid radiation transport algorithm. A detailed plan for the generation of the full algorithm will be developed, with a focus on parallelization and compatibility with existing commercial transport software. This plan will include thorough testing and validation stages.

## Anticipated Benefits

Potential NASA Commercial Applications: The combined stochastic and diffusion-based algorithm will be modularly compatible with existing commercial codes, allowing wide access to accurate thermal radiation predictions within research, academic, and design communities. Other defense applications include thermal radiation characterization from rocket nozzles/plumes, combustion chambers, and nuclear explosions. Commercial space launch organizations will have access to state-of-the-art thermal calculation capability, as well as design firms supporting the nascent space tourism industry. Ground-based applications for efficient radiation transport predictions are numerous, and include metal forming, lithography, curing, and many other high-temperature manufacturing processes.



Efficient, Multi-scale Radiation Transport Modeling, Phase I

## Table of Contents

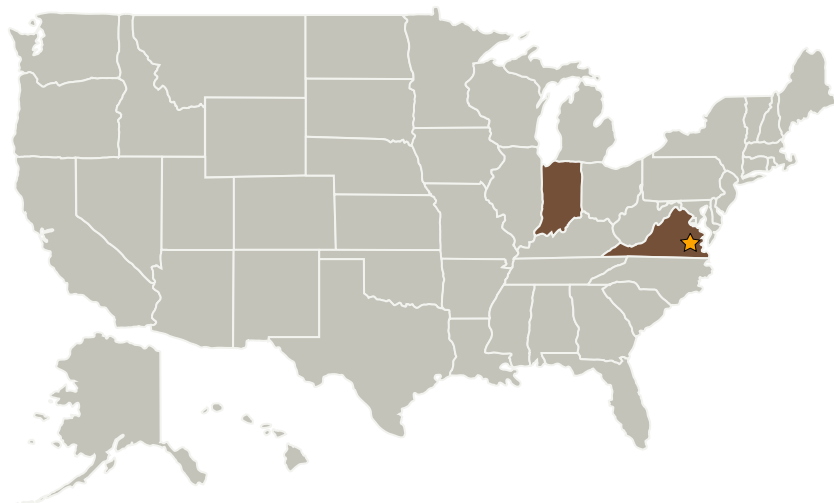
Project Introduction	1
Anticipated Benefits	1
Primary U.S. Work Locations and Key Partners	2
Project Transitions	2
Organizational Responsibility	2
Project Management	2
Technology Maturity (TRL)	3
Technology Areas	3

## Efficient, Multi-scale Radiation Transport Modeling, Phase I

Completed Technology Project (2009 - 2009)



## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Langley Research Center (LaRC)	Lead Organization	NASA Center	Hampton, Virginia
PC Krause and Associates, Inc.	Supporting Organization	Industry	West Lafayette, Indiana

## Primary U.S. Work Locations

Indiana	Virginia
---------	----------

## Project Transitions

**January 2009:** Project Start**July 2009:** Closed out

**Closeout Summary:** Efficient, Multi-scale Radiation Transport Modeling, Phase I Project Image

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Center / Facility:**

Langley Research Center (LaRC)

**Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

**Program Director:**

Jason L Kessler

**Program Manager:**

Carlos Torrez

**Project Manager:**

Christopher O Johnston

**Principal Investigator:**

Alexander J Heltzel

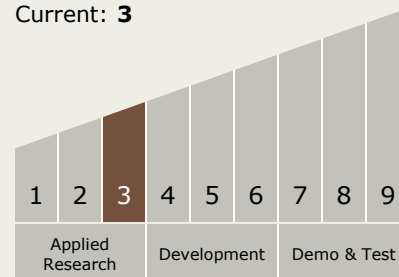
## Efficient, Multi-scale Radiation Transport Modeling, Phase I

Completed Technology Project (2009 - 2009)



### Technology Maturity (TRL)

Start: 3  
Current: 3



### Technology Areas

#### Primary:

- TX02 Flight Computing and Avionics
  - └ TX02.3 Avionics Tools, Models, and Analysis
    - └ TX02.3.2 Space Radiation Analysis and Modeling